ERDC Topographic Engineering Center

THE BATTLESPACE TERRAIN REASONING & AWARENESS BATTLE COMMAND (BTRA BC) JOINT-GEOSPATAL ENTERPRISE SERVICE (J-GES) GAZETTE

Volume 2, 1Q FY 2008

A message from the Program Manager ...

I would like to personally welcome you to the second edition of BTRA BC/J-GES Gazette. The goal of this publication is to provide timely, relevant information on each program and to educate the broader community on our missions. This edition will focus on upcoming J-GES experiments and showcase the wonderful research and products our sister labs execute in support of the BTRA BC program. As always, our bottom-line is to provide tangible products to the war fighter.

Dan Visone, PM BTRA BC/J-GES

The Team...

ERDC — U.S. Army Engineer Research and Development Center

ACS — atlantic consulting services

aer — Atmospheric and Environmental Research, Inc.

ARL

Chenega Corporation

ESRI

George Mason University

Howard University

Northrop Grumman — Defining the Future

SRI International

Tech Projects LLC

Viecore FSD

INSIDE THIS ISSUE:

Battlespace Terrain Reasoning and Awareness Battle Command

To increase the effectiveness and agility of Battle Command (BC) and the Military Decision Making Process (MDMP) through the application of geo-environmental data, information and knowledge, across the greatest extent possible throughout the force.

Joint-Geospatial Enterprise Service

Perform research, system engineering and analysis leading to a Geo-Environmental Services based Information Architecture supporting the C4ISR requirements of a net-centric, highly automated and autonomous force, ensuring power to the edge of the force.

Breaking NEWS!

ERDC-wide Demo

A demonstration event integrating the work of CRREL, CERL, GSL, and TEC for the BTRA-BC and GeoBML programs has been tentatively scheduled for Spring 2008. This will provide a great opportunity for the labs to show off their actionable geospatial information products under development as well as enhance the capabilities of the J-GES environment and GeoBML testbed to experiment with tactics, techniques, and procedures incorporating actionable geospatial information in the military decision-making process.

J-GES and the United States Military Academy (USMA)

J-GES has forged ties with the USMA's Operations Research Center for Excellence (ORCEN) as an outgrowth of MAJ Rainey's support to GSL within the BTRA-BC and GeoBML programs. LTC Robert Kewley, Research Director of the ORCEN, visited TEC in August and expressed interest in replicating a portion of the J-GES environment at West Point in order to support Course of Action generation and analysis. ACS and Viecore FSD, along with Martin Kleiner from the GeoBML team, traveled to USMA in late October to transfer the technology.

Geospatial Data and Near Real-Time Simulations

MÄK Technologies has been busy exploring the use of an ESRI geodatabase to supply the terrain data and features for their simulation, VR Forces. In late September, they visited TEC to demonstrate a successful integration with TGD data of White Sands Missile Range. Future work involves aligning their efforts with the BTRA and GeoBML programs, using products and software from both to influence the behavior of simulated entities.

BTRA-BC Commercial Joint Mapping ToolKit (CJMTK) Extension (BCE) Update

The objective of the BCE is to provide the BTRA analysis capabilities to the CJMTK Mission Application development community. BTRA performs research and development to create advanced geospatial analysis and processing capabilities, supporting a wide range of missions for the Warfighter. The CJMTK provides a geospatial toolkit for programs and projects to develop specific applications that are fielded to command and control and intelligence operators. The BCE effort provides a mechanism to transition the capabilities from BTRA to programs that can leverage those capabilities and field them to the Warfighter. The BTRA capabilities include analysis engines, data manipulation routines, and other software products in support of terrain reasoning. The BCE program staff will transition the BTRA capabilities by conducting testing, building Reference Implementation Sample Applications (RISAs) and packaging them for distribution to the CJMTK developer community. The following table depicts the current status of engine delivery, testing, and planned delivery to CJMTK of the BTRA engines.

Component	Expected Delivery by TEC	Test Harness Status	Integration Status	Planned Delivery to CJMTK (with RISA)
Slope Aspect Generator	Delivered	100%	100%	11/16/07
Complex Generator	Delivered	100%	100%	11/16/07
Standard Mobility	Delivered	100%	100%	11/16/07
Obstacle Generator	Delivered	100%	100%	11/16/07
Concealment Area Generator	Delivered	100%	100%	11/16/07
Network Generator	Delivered	N/A	95%	11/16/07
Movement Projection	Delivered	50%	85%	11/16/07
Common Data Service	Delivered	100%	90%	11/16/07
Movement Projection Web Service RISA	N/A	N/A	20%	11/27/07
Fields of Fire Generator	Delivered			12/18/07
Choke Points Generator	Delivered			12/18/07
Engagement Areas Generator	Nov 07			
FASST-C	Nov 07			
TSO Web Service RISA	N/A	N/A		1/11/08
9.3 Release of all Engines and RISA	N/A	N/A		2nd Quarter 08

Replication/Synchronization Experiment #1 Successful

The Joint-Geospatial Enterprise Services (J-GES) Program successfully conducted Replication/Synchronization Experiment #1 in May 2007. Replication is the process of making a copy of a database, while synchronization keeps the databases current. Replication is performed initially, while the synchronization occurs after the replica database is in place. During synchronization, changes, not complete copies of the database, are passed between systems. The replication/synchronization process insures that soldiers have a timely, coherent, understanding of the terrain.

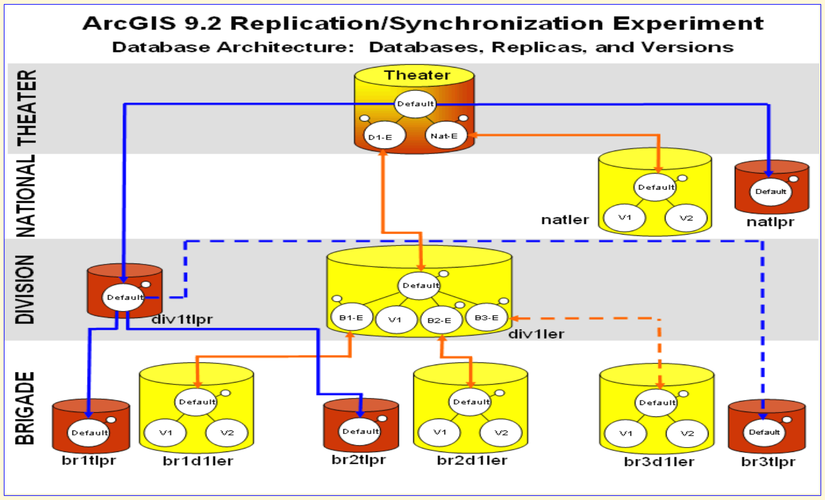
Replication/Synchronization Experiment #1 tested the out-of-the-box geodatabase replication/synchronization capabilities of ESRI's ArcGIS 9.2 software. The experiment included participants from the Topographic Engineering Center's J-GES Program and Operations Division, as well as geospatial analysts from the U.S. Army MANSCEN and ESRI. Engineers from the Combat Terrain Information Systems (CTIS) program provided oversight.

Using the Theater Geospatial Database (TGD) model with sample data from Hawaii, the experiment participants synchronized roads data from the Tactical Layer at echelons from Brigade, through Division, Theater, and National. Since the Theater manages the TGD, all other echelons were considered subordinate, even the National level.

There were two primary data flows. In the Editing Flow, users were only given data covering their specific Area of Interest. Their edits were passed to their next higher echelon for review, before being approved and passed up. The Editing Flow used two-way synchronization, so that edits could be made at both the lower and higher echelons.

In the Publishing Flow, the entire Theater Geospatial Database was pushed from the Theater down to lower echelons using one-way replication/synchronization. Thus, soldiers can edit data in their Area of Interest, but see data for the entire Theater.

The experiment tested both connected and disconnected operations, as well as web-based editing and synchronization. The After Action Report documents the lessons learned, as well as the training, personnel, and technology gaps.



Experiment #1 Architecture

Upcoming Events ...

BTRA BC:

BTRA Distributed Architecture Experiment - Architecture/network testing for engine deployment, geo-processing and web service deployment in commercial joint mapping toolkit (CJMTK) - Nov 07

BTRA BC Engine testing for CJMTK - Nov-Dec 07

BTRA Battle Engine (BBE) Subject Matter Expert Review - Dec 07

ERDC-wide Demonstration Meeting—Dec 07

Evaluation of Advanced Automated Geospatial Tools, Value Experiment #2 - Jan 08

J-GES:

VADM Murrett and LTG Van Antwerp visit - Nov 07

Evaluation of high resolution Buckeye Data and imagery - Value Experiment #3 - Jan 08

ESRI Image Server Experiment in support of Buckeye Imagery - Dec 07

Digital Topographic Support System integration—Dec 07

Buckeye Data Processing - Nov 07

ESRI 9.2 Replication/Synchronization Experiment #2 - Jan 08

Evaluate the performance of the PREACT web service application over a network - Dec 07

Imagery Value Experiment for Operations Division - Dec 07

3-D Web-based Visualization Experiment for Operations Division - Dec 07

Evaluate the performance of the ArcGIS Server licensing schema over a network for PREACT - Dec 07

Replication/Synchronization Experiment #2 Planned for 2008

The Joint-Geospatial Enterprise Services (J-GES) Program is currently planning Replication/Synchronization Experiment #2 for early 2008. This experiment will build on the lessons learned in Replication/Synchronization Experiment #1 and focus on the key recommendations. Two of the key new capabilities tested in Replication/Synchronization Experiment #2 are improved automation and the addition of mobile clients to the architecture.

Mobile ADF Web Services

The replication/synchronization process will be greatly simplified with automation and customization. While the out-of-the-box capabilities worked as advertised, one goal in this experiment will be to simplify a soldier's interaction with the software. Based on the Army's Concept of Operations (CONOPS) for replication/synchronization, much of the information required for the process will be specified in advance. Dialogues will reflect the soldier's operational language, rather than specific geographic information systems (GIS) terminology.

In addition to workstations at the National through Brigade levels, mobile clients below Brigade will be added in Replication/Synchronization Experiment #2.

Using ESRI Mobile Application Development Framework (ADF) and ArcGIS Server software, clients can edit data in connected or disconnected environments. Data can be synchronized whenever a connection between the mobile client and ArcGIS server is established.

A variety of mobile devices, including cell phones, Personal Digital Assistants (PDAs), and tablet personal computers, will be tested as part of the experiment. Participants in Replication/Synchronization Experiment #2 will include the Topographic Engineering Center's J-GES Program and Operations Division, the U.S. Army MANSCEN, ESRI and possibly others. Plans are to edit a Theater Geospatial Database over Fort Polk, LA.

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Image Server Experiment Underway

The Joint-Geospatial Enterprise Services (J-GES) Program is currently working with ESRI to test the ability of their ArcGIS Image Server product to perform on-the-fly orthorectification and mosaicking of the U.S. Army's Buckeye high resolution data.

Buckeye Color Imagery

Buckeye is a rapidly fielded, spiral development program of the U.S. Army Engineer Research and Development Center's (ERDC) Topographic Engineering Center (TEC). It has evolved to its current state rapidly. Buckeye provides soldiers with high quality battlefield information through high-resolution imagery and elevation data. The data produced through Buckeye is available to all of the U.S. Armed Services and intelligence communities via SIPRNET.

ArcGIS Image Server has the capability to perform on-the-fly orthorectification and mosaicking of large volumes of raw imagery, serving the resulting images to soldiers across the network. The product also performs some image processing operations as well, such as stretching, pan sharpening, and filtering data.

ArcGIS Image Server represents a new approach to thinking about imagery dissemination in the Army, where source imagery can be stored in its original format and processed on-demand. Using this philosophy, soldiers will no longer have to collect and store raw data, process the data to create orthophotos, and maintain duplicate copies of the imagery. This storage savings and rapid access are especially important for large data holdings.

In October 2007, ESRI demonstrated the basic capability to orthorectify a small sample Buckeye data on-the-fly at their research facility in Redlands, CA. Future work will move the capability to the J-GES Research Laboratory at TEC and expand the tests to include increasingly large volumes of Buckeye data. This experiment is supported by TEC's Operations Division and complements their on-going work with ArcGIS Image Server and Buckeye data. Currently, they are serving Buckeye orthophotos using Image Server.

If the J-GES ArcGIS Server Image Server experiment is successful, soldiers will routinely create orthophotos and mosaic imagery on-the-fly. This will reduce storage requirements, provide rapid access to imagery holdings, and decrease the time from data collection in the field to exploitation by Army soldiers.

J-GES Value Experiment #1:
Evaluation of Advanced Automated Geospatial Tools

Summary: The general purpose of these experiments is to assess the value of Geospatial Tools and Information to the Military Decision Making Process. The specific purpose of Value Experiment #1 was to assess the added value of Advanced Automated Geospatial Tools (AAGT), as represented by the Battlefield Terrain Reasoning and Awareness – Battle Command (BTRA-BC) tool set, in a terrain analysis scenario. Eighteen students in the Advanced Terrain Analysis Course (ATAC) were tasked to perform identical terrain analysis tasks on similar terrain using the Digital Topographic Support System (DTSS) with and without the added BTRA-BC functionality. A statistical analysis of the results was conducted (portions of which are still in progress).

Results: The value added of BTRA-BC was assessed by the following measures:

- Time to task completion.
- Objective quality of the output – Evaluators counted specific participant-identified Tactical Spatial Objects (TSO), such as Mobility Corridors and Avenues of Approach, and answered yes/no to questions related to output.
- Subjective quality of the output – Subject Matter Experts (SME) evaluated the information presented and the clarity of the presentation of the output.
- Knowledge of the impact of terrain on the military problem – SMEs evaluated the participants' answers to questions requiring reasoning about the terrain.
- Participants' perception of the value of BTRA-BC – Participants completed questionnaires designed to elicit these perceptions.

On average, participants completed similar terrain analysis tasks 64% faster using DTSS with BTRA-BC than without BTRA-BC. In addition, participants who used DTSS with BTRA first completed the tasks using DTSS without BTRA-BC 27% faster than participants that used DTSS without BTRA-BC first.

On average, participants generated higher quality products using DTSS w/ BTRA-BC than w/o BTRA-BC for both objective and subjective quality measures. The level of knowledge and understanding of the effects of terrain for participants using BTRA-BC and those not using BTRA-BC were statistically indistinguishable.

Lastly, participants thought that DTSS with BTRA-BC assisted them in completing the tasks faster and with better quality than using DTSS without BTRA-BC. They thought that the use of AAGT, specifically BTRA-BC, does not reduce their understanding of the terrain.

Overall, Value Experiment #1 indicated significant added value through the use of AAGT as represented in BTRA-BC: (1) There was substantial reduction in the time (man-hours) required for terrain analysis tasks, (2) The quality of the output was improved without degrading the analysts' knowledge of the effects of terrain.

J-GES Value Experiment #2: Evaluation of Advanced Automated Geospatial Tools in a Mission Context

Summary: Value Experiment #2 is a direct follow-on to Value Experiment #1 which assessed the added value of Advanced Automated Geospatial Tools (AAGT) in a terrain analysis scenario. The specific purpose of Value Experiment #2 is to access the value added of Battlefield Terrain Reasoning and Awareness – Battle Command (BTRA-BC) tools in a military planning scenario. According to the current experimental plan, sixteen (16) army junior officers (O3-O4) with staff planning experience will be tasked to perform identical planning tasks on similar terrain using Commander's Support Environment (CSE), an advanced Command and Control (C2) system, with and without BTRA-BC functionality. A statistical analysis will be performed on the data gathered.

Environment: Originally sponsored by DARPA, CSE was developed by Viecore FSD, Inc. in response to the Future Combat System (FCS) requirements for mobile C2. Combining sensor data, intelligent agents, and 2D & 3D visualization, CSE provides a commander's staff with the tools to filter, assess and respond to critical battlefield information.

Experimental Design: The experiment is structured as a within-subjects design, i.e. participants will perform similar tasks using CSE with and without BTRA-BC. The tasks involve planning a maneuver schema for the companies of a Brigade Combat Team (BCT) battalion. The tasks include terrain analysis, route planning, concealment analysis, selecting hide and battle positions, evaluation of hostile force possible Course of Action (COA), and Named Area of Interest (NAI) generation. The order of the trials with BTRA-BC and without BTRA-BC and the order of the scenarios will be counter-balanced and randomly assigned in order to control the effects of these parameters in our analysis.

Hypotheses: The experiment is designed to test the following hypotheses:

- The participants perform tasks faster with BTRA-BC than without BTRA-BC.
- Products produced by participants are of higher quality when using BTRA-BC than without BTRA-BC.
- Knowledge and understanding of the effects of terrain on decision-making are at least as good for participants using BTRA-BC as for those not using BTRA-BC.
- The participants believe BTRA-BC helps them complete tasks faster and produce higher quality output, and that their knowledge and understanding of the effects of terrain are as good as when not using BTRA-BC.

The value added by BTRA-BC tools will be assessed by the following measures:

- Time to task completion: This measure was highly significant when evaluating Tier 1 tools, but the opinion of SMEs is that with more complex problems the participants will use all the time available to refine their products. Therefore this measure may not be as significant in Value Experiment #2.
- Subjective quality of the output: Subject matter experts (SMEs) will evaluate the information presented and the clarity of the presentation of the output. Because of (1) above this may be the most important of the measures.
- Knowledge of the impact of terrain on the military problem – SMEs will evaluate the participants' answers to questions requiring reasoning about the terrain.
- Participants' perception of the value of AAGT – Participants will complete a questionnaire designed to elicit these perceptions of BTRA's effect on how quickly they can produce planning products, the quality of their products, and their terrain understanding.

J-GES Value Experiment #3: Evaluation of High Resolution Buckeye Data and Imagery

Summary: Value Experiment #3 is a departure from Value Experiments #1 and #2 which assessed the value-added of the Battlefield Terrain Reasoning and Awareness – Battle Command (BTRA-BC) toolset. Value Experiment #3 will assess the military planning value of high resolution imagery and Digital Elevation Model (DEM) data, specifically data generated by Buckeye, as compared to conventional, Controlled Image Base (CIB), one meter resolution data. The environment and experimental design are similar to Value Experiments #1 and #2, but the metrics by which we evaluate added value will be revised to accommodate the change from evaluating a tool set (data remaining constant) to evaluating the effect of better data (tool set remaining constant).

Environment: Like Value Experiment #2, Commander's Support Environment (CSE) will be the operating environment through which the evaluation of Buckeye data will be made.

Data and Location: As both Buckeye (high resolution) and Controlled Image Base (CIB) (1 meter resolution) data are available on Iraqi cities, the location chosen will be in Iraq.

Experimental Design: The experiment is structured as a within-subjects design where the participants will perform tasks involved in planning the transit from a safe haven to attack positions and then an assault on an urban facility. The participants, senior enlisted and junior officer personnel who have in-country experience, will be planning for platoon sized units. Participants will be using automated route planning (modified from BTRA-BC), imagery and 3D visualization software to plan the movement and attack. Two scenarios with highly similar urban terrain and objectives will be developed for use both with CIB and Buckeye data. Participants will be trained in the use of CSE and the 3D visualization software prior to running the experiment.

Hypotheses: The experiment is designed to test the following hypotheses:

- Participants would perform tasks faster with Buckeye data than with conventional CIB data.
- The products produced by participants would be of higher quality when using Buckeye data than with conventional data.
- Knowledge and understanding of the effects of terrain on decision-making would be as high when using Buckeye data as when using conventional data.
- Participants believe that Buckeye data allows them to complete tasks faster, produce higher quality output and that their knowledge and understanding of the effects of terrain are as good as when using conventional data.

BTRA BC Laboratory Contributions: Cold Regions Research Engineering Laboratory (CRREL)

The Cold Regions Research Engineering Laboratory's (CRREL) role in BTRA involves predicting the effect of weather on the state-of-the-ground and on Army systems and sensors. To achieve these objectives CRREL and Atmospheric and Environmental Research, Inc. (AER) have developed FASST (Fast All-Season Soil Strength), a 1-D physics based model that predicts the state-of-the-ground. This physics-based energy and moisture balance model requires knowledge of the physical, optical, thermal, and hydrological properties of the soil and the weather conditions. FASST predicts profiles of temperature and moisture, soil strength in terms of the Cone Index (CI) and the Related Cone Index (RCI), slippery factor, freeze/thaw depth, and snow depth when applicable. To obtain the necessary weather conditions needed for the surface energy and moisture budget calculations in FASST, CRREL developed procedures and algorithms to download the Air Force Weather Agency's (AFWA) Weather Research Forecast (WRF) mesoscale weather information associated with four weather regions; Korea, CONUS, Europe, and Southwest Asia. The weather parameters required by FASST, and to support other BTRA weather requirements, are extracted from the WRF information and stored in a database available to BTRA participants. Weather parameters not directly available from the WRF but required by BTRA are calculated using algorithms developed by CRREL researchers. For example, solar and infrared fluxes, an important component of the surface energy budget, are computed from WRF cloud information. Other BTRA applications use the FASST predicted parameters. For example, the BTRA Standard Mobility model (StndMob) uses the FASST predicted soil strength, freeze/thaw depth, slippery factor, and snow depth to predict mobility and trafficability for Army vehicles. To support Air Maneuver Net requirements, CRREL developed algorithms to extract WRF upper air weather parameters to supplement the extracted WRF surface weather parameters.

FASST predicts a time series of surface temperatures for all the polygonal elements of a BTRA complex. The physical temperatures are converted to in-band thermal radiance for use with the infrared system performance algorithms developed by CRREL and AER. The InfraRed Sensor Performance (IRSP) algorithm is unique and only requires generic information on the characteristics of the IR sensor and the target. The weather-affected state-of-the-ground and the weather conditions at the time of interest drive the IRSP predictions. An important element governing the IRSP is the IR clutter within the Area Of Interest (AOI). The IRSP algorithm includes the diurnal variation in IR ground clutter associated with solar heating. CRREL and AER have also developed an Acoustic Sensor Performance (ASP) capability. The ASP predicts the performance of acoustic sensors, including the human ear.

Recent Events ...

BTRA BC:

Systematic SitaWare training and evaluation - Sept 07

OSD Technology Transition Initiative Review - Oct 07

GeoInt Conference BTRA demonstrations - Oct 07

BTRA BC Overview brief at the Topographic Production Capability In Progress Review - Oct 07

Battle Management Language Conference at George Mason University - Oct 07

J-GES:

Mapping Human Terrain (Map-HT) training and demonstration - network performance testing and commercial-off-the-shelf enhancement evaluation supporting the training and demonstration of Map HT capabilities - Oct 07

Evaluation of MÄK's GIS Enabled Modeling and Simulation software - Oct 07

BTRA BC and the Cold Regions Research Laboratory

Continued from page 10

Figure 1 depicts the flow of data and the interaction of the CRREL/AER applications developed to support BTRA and the prediction of infrared and acoustic sensor performance. The weather effects (WX) database is populated after each WRF model run. The WRF produces forecast with base times of 0600 and 1800 GMT or 0000 and 1200 GMT, depending on the WRF window. The arrows in the figure indicate the direction of flow of information. In the case of the double arrows, the information flows in both directions. For example, the IRSP application uses the surface temperature/surface radiance from the BTRA database, calculates the IRSP, and stores the values in the BTRA database. The BTRA database is populated with information from the WX database only during BTRA exercises.

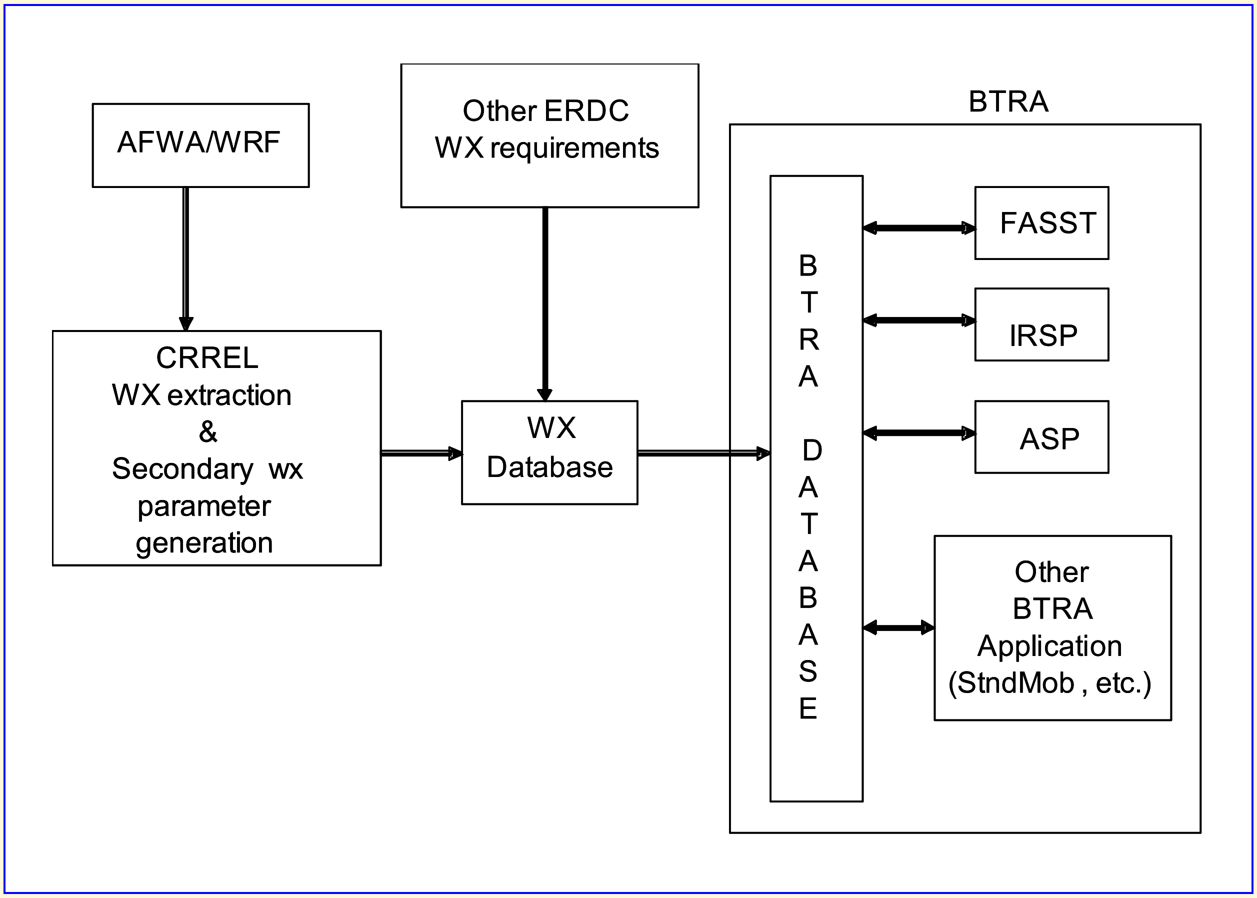


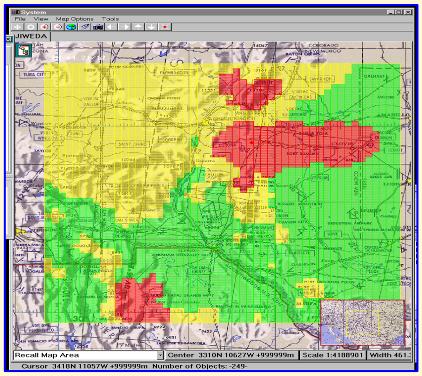
Figure 1. Data flow and CRREL/AER applications interaction with BTRA

BTRA BC Laboratory Contributions:
Army Research Laboratory (ARL)

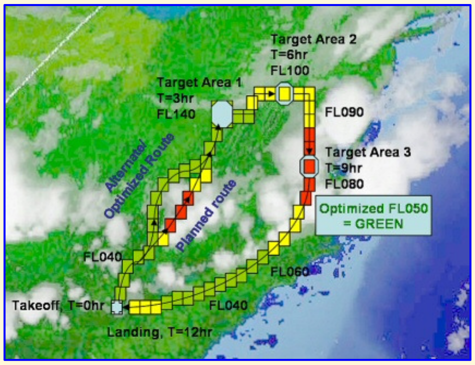
BTRA-BC Fact Sheet: Army Research Lab (ARL) Contributions

The Battlefield Environment Division of ARL focuses research and development efforts devoted to atmospheric and environmental effects on soldiers, systems, and operations. For the BTRA-BC ATO, ARL is providing the following technology:

Integrated Weather Effects Decision Aid (IWEDA)



- Meteorological critical values are the lowest common denominator in assessing weather support requirements, specific effects of weather on any system, subsystem, operation, tactic, and personnel, and tactical advantage in adverse weather conditions.
- IWEDA provides a "red-amber-green" mission planning aid for Army commanders to advise them when and where the environmental conditions currently exceed (or are forecast to exceed) levels of marginal (amber) or severe (red) impact to their systems, operations, or personnel.
- IWEDA can be used to create spatial objects of adverse weather conditions which can be translated to “no fly” 3-D airspace volumes or “no passage” 2-D ground travel domains.



Aviation Weather Routing Tool (AWRT)

- Predicts and displays weather conditions for a 4-D flight route.
- Relies on IWEDA technology to generate impacts across airspace.
- Applies IWEDA weather impacts 4-D grid to specific flight routes.
- Route optimization scheme determines the best routing for aircraft missions predicted to encounter adverse flying conditions and/or restricted airspace regions.
- Will be used to route unmanned aircraft into/out of BTRA Air Maneuver Net flight domains.

Weather Running Estimate-Nowcast (WRE-N)

- The Air Force Weather Agency (AFWA) provides regional battlefield weather forecasts.
- WRE-N takes those forecasts and provides highly effective local/tailored weather updates as local corrections to the regional forecast data cube at Army-tailored domains & resolutions.
- WRE-N can be used to provide Mission Execution Forecast data to supplement the AFWA forecast grids used for IWEDA and AWRT applications in the BTRA experimental scenarios.

BTRA BC Laboratory Contributions: Construction Engineering Research Laboratory (CERL)

ERDC-CERL

ERDC-CERL seeks to provide commanders at Brigade and below an unmatched tactical understanding of the Battlespace so that they can develop integrated air and ground battle plans that exploit terrain and weather. The Army's use of Unmanned Aerial Systems (UAS) is rapidly expanding and has the potential to support a broad spectrum of operations. According to FMI 3-04.155 (Army Unmanned Aircraft Operations Systems, US Army 2006), UAS support for Army operations includes:

Intelligence, Surveillance and Reconnaissance (ISR)
Detection, acquisition, designation, suppression and destruction of enemy targets
Battle damage assessment
Communications relay
Decoy and deception operations

Current UAS are general-purpose assets that operate much like a manned aircraft; one Service, one aircraft, one pilot, multiple purposes. Pressure to reduce force structure and cost while increasing the effectiveness of these assets will lead the Army to operate UAS constellations comprised of many special-purpose aircraft from several Services. High-altitude "hunters" will collect data over a wide area with sophisticated sensors. Medium-altitude aircraft will confirm targets and provide high-resolution overlays. Low cost "killers" will serve as the constellation's teeth. All of these aircraft will operate semi-autonomously enabling 6-20 aircraft to be controlled by a single operator.

In this context, it becomes imperative to enable mission planners to develop tightly coupled plans linking air and ground operations. Air Maneuver Networks (AMN) provide the computational infrastructure to support such integrated planning and will used in conducting controlled experiments to gain insight as to how actionable terrain, atmospheric and weather information are most effectively integrated into Battle Command System of Systems (SoS), staffs, processes and functions to enhance agile decision making.

To this end, ERDC-CERL has been acting as the AMN lead integrator. Several algorithms have been developed to generate AMN's that maximize coverage of key portions of the terrain while respecting UAS operating parameters such as minimum altitude above ground. The Integrated Weather Effects Decision Aid developed by the Army Research Laboratory is being incorporated to provide an understanding of the impact of weather on the UAV platform. Work to add BTRA's infrared sensor performance algorithms will begin shortly. With these elements in place, it will be possible to compare and contrast the performance and quality of UAS mission plans using different combinations of network generators and network solvers.

From the user's perspective, this technology will be transparent. Context-specific information will be accessed from GeoBML messages, enabling the UAS Commander to identify high value aerial observation points and the Ground Commander to predict the quality and availability of ISR data based on the current UAS mission plans and weather forecast.

BTRA BC Laboratory Contributions:
Geotechnical and Structures Laboratory (GSL)

GSL-BTRA-BC Fact Sheet

Purpose: This research will provide Tactical Decision Aids (TDA) and Tactical Spatial Objects (TSO) for Battle Terrain Reasoning and Awareness-Battle Command (BTRA-BC) capabilities to create actionable information of terrain and weather impacts on units, systems, platforms, and soldiers. The BTRA-BC will enable agile BC decision making through net-centric, multi-echelon Terrain Reasoning Services and embedded applications. The GSL BTRA-BC's TDAs will be designed to empower the BC at the edge of the networked force. These capabilities will focus on tactical logistics, vehicle gap crossing, tactical bridging analysis, terrain inferencing for mobility predictions and supporting the development of a Geospatial Battle Management Language (GeoBML).

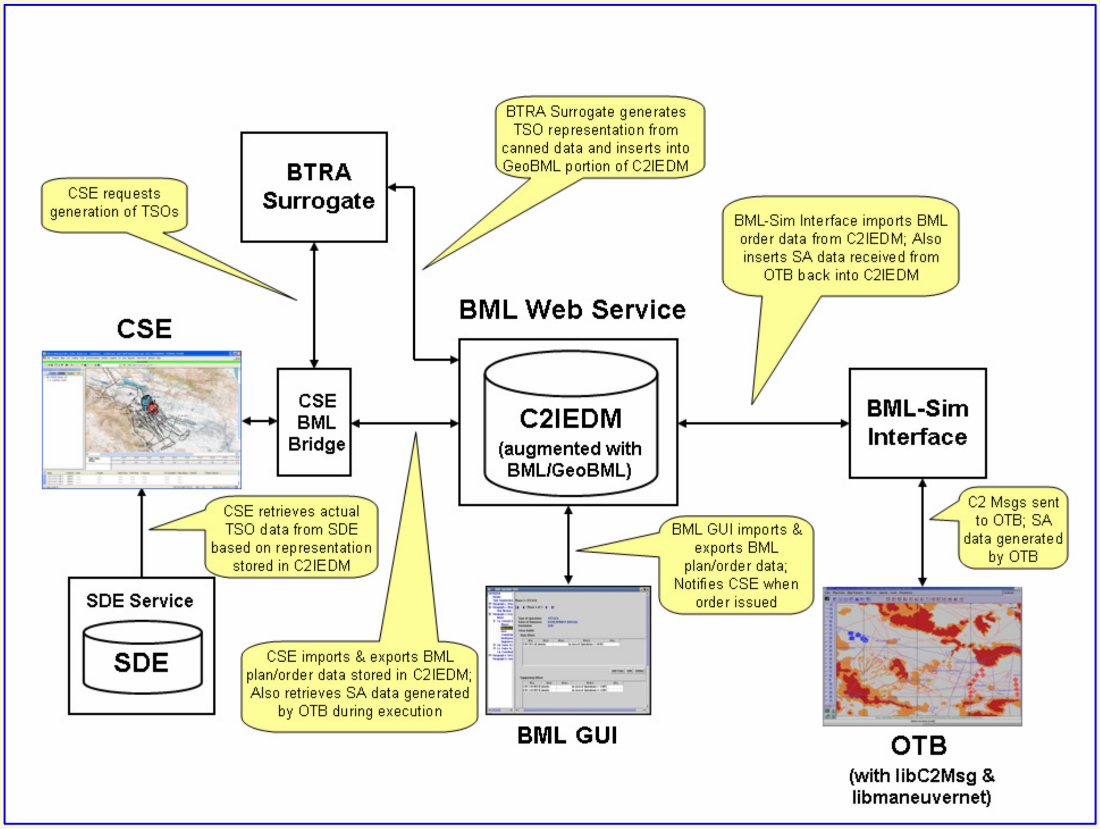
Background: The Geotechnical and Structures Laboratory (GSL) is the center of expertise within the Engineering Research and Development Center (ERDC) for predicting ground vehicle mobility and maneuvers throughout the battlefield. The GSL has developed vehicle mobility models for the BTRA along with the supporting terrain inferencing to provide the necessary terrain attributions for mobility predictions that create the BTRA maneuver network. The GSL will continue to enhance and support these vehicle mobility and inferencing products for the BTRA-BC program. The GSL will also support the development of geoBML which is an unambiguous description of geospatial abstract objects within the frame work of the Battle Management Language (BML). The GSL will support the geoBML by developing links between OneSAF simulations and the Battle Command systems to insure that maneuver/mobility representations are consistent within these systems.

Tactical Decision Aids (TDA): TDAs are supported within the BTRA-BC research program through the development of TSOs. The GSL will support the BTRA-BC by developing TSO's for tactical logistics, vehicle gap crossing, and tactical bridging analysis. Tactical logistics supports gathering data against pertinent battlefield components, analyzes their impact on sustainment, and integrates them into tactical planning so that support actions are synchronized with maneuver. This research will identify and assess those factors which facilitate, inhibit, or deny support to units traversing the existing BTRA maneuver network. The first tactical logistics TSO will focus on Health Service Support (HSS) functions for medical evacuation. The vehicle gap crossing TDA will conduct crossing analysis over unimproved gaps throughout the maneuver network. The tactical bridging analysis TDA will conduct bridge placement analysis for linear features along the maneuver network to identify locations where fielded bridging assets can be used to cross gaps.

Products: The GSL will provide TDAs that facilitate coherent decision making within a distributed BC. These products will enhance situational awareness of the maneuver network and support the concept of assured mobility.

Geospatial Battle Management Language (GeoBML)

In the last issue of the *Gazette*, GeoBML was introduced at the conceptual level. However it also exists in the physical world in the form of a reference implementation – the GeoBML Testbed. The system currently consists of four major components – Commander's Support Environment (CSE), the GeoBML web service, BTRA, and OneSAF Testbed (OTB).



At Integration Event 3a, held in New Jersey during the last week of July, the GeoBML team stabilized the testbed with one brigade CSE node planning and issuing an Operations Order (OPORD) via the Command and Control Information Exchange Data Model (C2IEDM) to two separate battalion-level CSE nodes. The battalion-level OPORDs that were subsequently planned and issued then initialized an instance of OTB. This capability was demonstrated at the BML Conference (GMU Prince William Campus, 16-17 October).

The GeoBML team also welcomed a new subject matter expert to the team – MAJ Mark Rainey. MAJ Rainey teaches in the Systems Engineering Department at the United States Military Academy (USMA) and will be advising the researchers at GSL on developing Tactical Spatial Objects (TSOs) that support logistical planning. He is a Combat Engineer (CE) officer with significant experience, having served two years as a CE company commander that included a combat deployment to Iraq. There is no doubt he will prove to be an invaluable resource to BTRA and GeoBML.

Ongoing efforts include performing operational, functional, and technical evaluations of Systematic Software Engineering's SitaWare C2 product with respect to the GeoBML testbed, as well as partnering with MÄK Technologies to incorporate BTRA products (maneuver network and movement projection) into their near real-time entity level simulation engine.

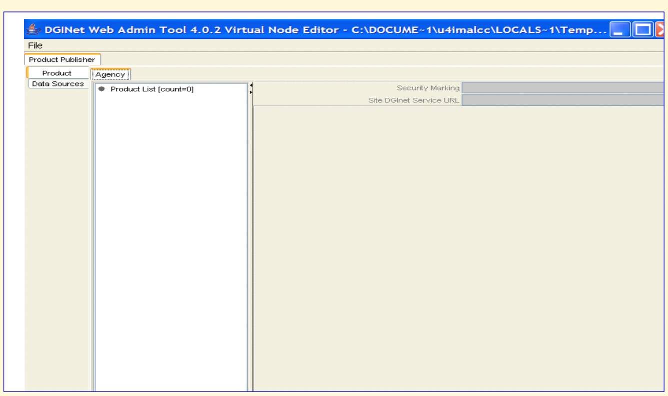
DGINet Virtual Node Software

ESRI completed the development of 'Virtual Node' software for the Distributed Geospatial Intelligence Network (DGInet) in September 2007. Funded by the Topographic Engineering Center's (TEC) Joint - Geospatial Enterprise Services (J-GES) Program, this software allows agencies to make their geospatial data available to the Intelligence Community via DGInet, without requiring them to support the software and hardware infrastructure of traditional DGInet nodes.

DGInet hosts an active community of data providers and users. There are currently over 1000 layers of geospatial data from multiple intelligence agencies and DGInet servers received over 8 million hits in 2006. Today geospatial data is served from DGInet nodes, which require an organization to supply a server, install a specific software suite, and provide technical support. While this model works well for larger organizations, smaller organizations have found it difficult to fund, resource, and support DGInet nodes.

The 'Virtual Node' concept overcomes the problem of traditional DGInet nodes. Using the lightweight 'Virtual Node' software (see below), organizations simply create DGInet-compatible metadata that points to their geospatial data holdings. The metadata is uploaded to a traditional DGInet node, where it is served to the entire DGInet community. From a DGInet user's perspective, the geospatial data can be viewed and accessed like any DGInet data.

During the summer of 2007, the J-GES research team, TEC Operations Division, and National Ground Intelligence Center tested the 'Virtual Node' software using the Operations Division's Water Resources Data Base (WRDB) and Urban Tactical Planner (UTP). A production version of the software will be available to Department of Defense organizations later this year.



DGInet 'Virtual Node' Interface

'Virtual Node' Software

The 'Virtual Node' software is a lightweight client written in Java. It can be installed on a personal computer and creates the metadata for DGInet to point to an agency's geospatial data. Organizations with limited resources can now make their geospatial data available to the wider Intelli-

Distinguished Visitors

September 27th, 2007
Geospatial Tiger Team:

Mr. Al Resnick
Director, Requirements Integration, TRADOC ARCIC

Mr. Ron Bechtold
CIO/G6

BG Tom Cole
Deputy PEO IEW&S

Colonel Chris O'Connor
Battle Command Directorate

Mr. Alan Sowder
DCS, G2

Colonel Thomas Crabtree
Director TPIO-TD

LTC Dale Kornuta
TPIO-TD, Chief TVC

October 2, 2007
National Geospatial-Intelligence Agency

Mr. Keith Masback

Mr. Steven Wallach

Mr. Peter Rowley

Mr. Fred Cirillo

Mr. Keith Barber

Major James Pugel

October 4 , 2007
OSD Acquisition Technology & Logistics Office

Mr. Ben Riley

Geographic Information System Enabled Modeling and Simulation (GEMS)

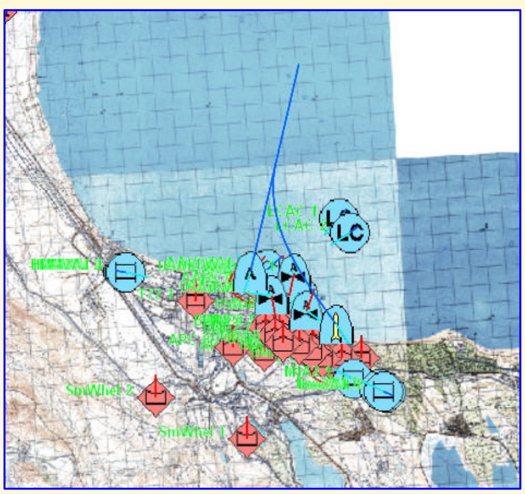
Geographic Information Systems (GIS) and Modeling & Simulation

The Joint-Geospatial Enterprise Services (J-GES) Program received and installed MÄK Technologies newly developed GIS-to-SIM application in October 2007, thanks to the efforts of Mr. Dave Lashlee (Associate Technical Director, TEC).

The innovative GIS-To-SIM technology enables ArcGIS users to integrate simulation feeds from MÄK's VR-Forces product or active simulations with ArcMap and ArcGlobe.

GIS-to-Sim Toolbar

Installed as a toolbar, the software supports three simulation standards: Distributed Interactive Simulation (DIS), High Level Architecture (HLA), and the Test and Training Enabling Architecture (TENA).



Simulation Display in ArcMap

GIS-to-SIM leverages ESRI's Dynamic Display Technology to display movement in real-time, while maintaining the ability to pan and zoom the display. Dynamic Display Technology supports rapid refresh of the display for smooth movement of units on the display. The simulation feed can be toggled on and off like other layers; moving entities can be queried. Military unit symbols may be displayed with MIL-STD 2525B symbology using the Military Overlay Editor (MOLE) or graphic pictorial icons.

GIS-to-SIM is a first step in meeting the Army's goal to train and fight using common data and applications.

The installation of GIS-to-SIM software establishes a solid link between the J-GES Program and the Modeling & Simulation (M&S) community and forms the foundation for future cooperative research and development efforts.